ASSIGNMENT 2

Textbook assignment: Chapter 2, "Servos," pages 2-1 through 2-38. Chapter 3, "Gyros," pages 3-1 through 3-27. Chapter 4, "Related Devices," pages 4-1 through 4-12.

2-1. A servo is normally designed to move (a) what type of load to (b) what type of positions?

1. (a) Small (b) Exact
2. (a) Small (b) Approximate
3. (a) Large (b) Exact
4. (a) Large (b) Approximate

2-2. Servo systems can be found in which of the following forms?

1. Pneumatic
2. Hydraulic
3. Electromechanical
4. Each of the above

2-3. Which of the following systems are control systems?

1. Open-loop
2. Closed-loop
3. Both 1 and 2 above
4. Inductive-loop

2-4. A servo system is defined as which of the following types of control systems?

1. Open-loop
2. Closed-loop
3. Both 1 and 2 above
4. Inductive-loop

2-5. Which of the following is a basic difference between an open-loop control system and a closed-loop control system?

1. Number of loops
2. Size of the load
3. Speed of movement
4. System of feedback

IN ANSWERING QUESTIONS 2-6 THROUGH 2-8, MATCH THE FUNCTION LISTED IN COLUMN B TO THE SERVO COMPONENT LISTED IN COLUMN A THAT ACCOMPLISHES THE FUNCTION.

A. SERVO COMPONENTS	B. FUNCTIONS
2-6. Synchro control system	1. Moves the load
2-7. Servo amplifier	2. Provides power
2-8. Servo motor	3. Controls movement
	4. Converts dc to ac

2-9. In a dc position servo system, what characteristic of the error signal determines the direction in which the load is driven?

1. Amplitude
2. Frequency
3. Polarity
4. Phase

2-10. The sum point in a position servo system combines what two signals to produce an error signal?

1. Response and output
2. Feedback and Output
3. Feedback and input
4. Output and input

2-11. A position servo system exhibits a series of overtravels. This condition is known by which of the following terms?

1. Hunting
2. Overdamping
3. Undershooting
4. All of the above

2-12. A velocity servo has which of the following characteristics?

1. Senses position of the load; no error signal at correspondence
2. Senses position of the load; error signal present at correspondence
3. Senses speed of the load; no error signal at correspondence
4. Senses speed of the load; error signal present at correspondence

2-13. What device is usually used to provide feedback in a velocity servo loop?

1. Potentiometer
2. Tachometer
3. CT
4. CX

2-14. For a servo system to operate smoothly and efficiently, it must have balance between which of the following factors?

1. Acceleration and speed
2. Inertia and oscillation
3. Amplification and damping
4. Overshooting and feedback signal

2-15. When friction-clutch damping is used in a servo system, the first overshoot of the load may be characterized as

1. small
2. large
3. reversed
4. eliminated

2-16. Error-rate damping is considered to be better than friction or friction-clutch damping because of which of the following characteristics of the error-rate damping system?

1. A large error signal of short duration will not be damped
2. A small error signal of short duration will not be damped
3. A large change in the error signal causes maximum damping
4. A small change in the error signal causes maximum damping

2-17. Under what condition would a servo system that is properly designed and operating correctly have an oscillating load?

1. The input signal is large in amplitude
2. The input signal oscillates
3. Error-rate damping is used
4. Friction damping is used

2-18. A servo system is found to be "noisy." If the bandwidth of the servo amplifier were adjusted to reject the unwanted noise signals, which of the following characteristics of the servo system would be affected?

1. Amplifier gain
2. Power requirements
3. Correspondence position
4. Error-detection capability

2-19. Which of the following devices can be used as a position sensor in a servo system?

1. A summing network
2. An E-transformer
3. A potentiometer
4. A CT

2-20. Which of the following devices are magnetic error detectors?

1. CXs
2. E-transformers
3. Summing networks
4. All of the above

2-21. A dc rate generator is used in which of the following loops of a velocity servo system?

1. Prime mover
2. Feedback
3. Control
4. Error

2-22. What is the function of a modulator in a servo system?

1. To change the frequency of an ac error signal
2. To impress an ac error signal on an ac carrier
3. To convert a dc error signal to an ac error signal
4. To convert an ac error signal to a dc error signal

2-23. In a servo system that uses a modulator, what characteristic of the modulator output determines the direction of load movement?

1. Amplitude
2. Frequency
3. Polarity
4. Phase

2-24. What phase relationships between the input and reference signals are sensed by a servo demodulator?

1. 0º and 180º
2. 45º and 225º
3. 90º and 270º
4. 135º and 315º

2-25. In a properly operating servo system, what is the phase relationship between the reference voltages to the error detector and the demodulator?

1. In phase only
2. 180º out of phase only
3. Out of phase; somewhere between 0º and 180º
4. In phase or 180º out of phase, depending on the demodulator input

2-26. Which of the following should be a characteristic of a servo amplifier?

1. Narrow frequency band
2. High output impedance
3. 180º phase shift
4. Low noise level

2-27. An ac servo motor would probably be used instead of a dc servo motor in which of the following situations?

1. To move heavy loads at a constant speed
2. To move heavy loads at variable speeds
3. To move light loads at a constant speed
4. To move light loads at variable speeds

2-28. Which of the following circuits that is required in a multispeed servo system is NOT required in a single-speed servo system?

1. Position sensor
2. Error detector
3. Feedback loop
4. Synchronizer

2-29. In a two-speed servo system such as that described in the text, which of the following components controls the movement of the load at 2º but does NOT control the movement of the load at 10º?

1. Fine CT
2. Coarse CT
3. Synchronizer
4. Servoamplifier

2-30. In which of the following situations should a magnetic amplifier be used instead of a conventional amplifier?

1. When a small load is to be driven at high speeds
2. If great accuracy is required in positioning the load
3. If a dual-speed servo system is required
4. When a heavy load is to be moved

2-31. Most servo systems used in the Navy are of which of the following types?

1. Open-loop
2. Multi-loop
3. Single-loop
4. Summing-loop

2-32. Which of the following objects has gyroscopic properties?

1. A spinning top
2. A wheel on a moving bicycle
3. The moving blade assembly of an electric fan
4. Each of the above

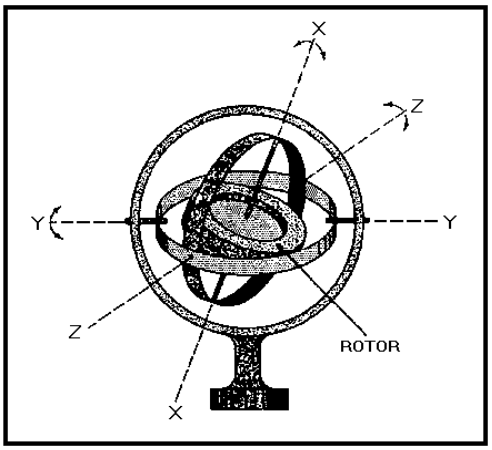

Figure 2A.—Gyro model, universally mounted.

IN ANSWERING QUESTION 2-33, REFER TO FIGURE 2A.

2-33. Which of the following axes, if any, is the gyro spin axis?

1. X-X
2. Y-Y
3. Z-Z
4. None of the above

2-34. The ability of a gyro to maintain a fixed position in space is referred to by what term?

1. Precession
2. Rigidity
3. Apparent rotation
4. Gimbal-stability

2-35. A gyro will resist all forces that attempt to change its

1. location
2. spin axis direction
3. speed of rotation
4. center of gravity

2-36. What action takes place when an outside force attempts to tilt the spin axis of a gyro?

1. The gyro precesses in the direction of the applied force
2. The gyro precesses in a direction opposite to the applied force
3. The gyro precesses in a direction at a right angle to the applied force
4. The gyro remains fixed in its original position

2-37. For a gyro to be universally mounted, it MUST have a total of how many gimbals, if any?

1. One
2. Two
3. Three
4. None

2-38. Of the following factors, which one does NOT affect rigidity?

1. Rotor speed
2. Rotor shape
3. Rotor weight
4. Rotor position

2-39. The forces that act through the center of gravity of a gyro and do NOT cause precession are referred to by what term?

1. Forces of translation
2. Forces of induction
3. Forces of isolation
4. Forces of erection

2-40. Which of the following factors determine(s) the amount of precession that will result from a given applied force?

1. Rotor speed
2. Rotor weight
3. Rotor shape
4. All of the above

2-41. Which of the following factors determine(s) the direction a gyro will precess in response to a particular force?

1. Speed of the rotor's spin
2. Shape of the rotor
3. Direction of the rotor's spin
4. All of the above

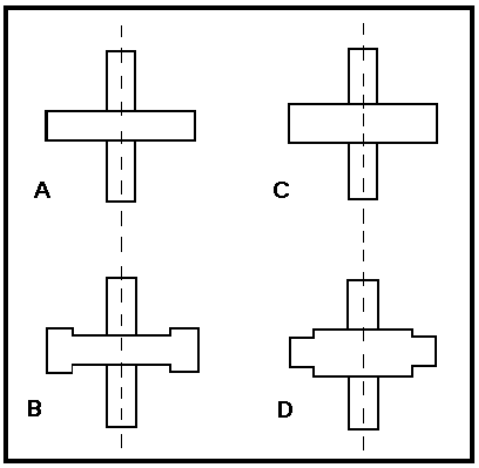

Figure 2B.—Rotors of equal weights but different shapes.

IN ANSWERING QUESTION 2-42, REFER TO FIGURE 2B.

2-42. If all of the rotors are rotated at the same speed, which one will have the greatest rigidity?

1. A
2. B
3. C
4. D

2-43. According to the right-hand rule for gyro precession, what does the thumb indicate?

1. Spin vector and axis
2. Torque vector and axis
3. Precession vector and axis
4. Axis of rotor rotation only

2-44. Which of the following is a universally mounted gyro?

1. A one-degree-of-freedom gyro
2. A two-degrees-of-freedom gyro
3. A restrained gyro
4. A rate gyro

2-45. A free gyro at the Equator appears to tilt. What is the approximate total number of degrees it will tilt in 4 hours?

1. 60º
2. 90º
3. 120º
4. 180º

2-46. Which of the following factors is NOT a cause of mechanical drift?

1. Unbalance
2. Friction
3. Apparent precession
4. Gimbal inertia

2-47. Which of the following is a purpose of a gyro-erection system?

1. To precess the gyro to its operating position
2. To prevent a gyro from precessing once the rotor is up to speed
3. To establish a vertical position to which the gyro position may be compared
4. Each of the above

2-48. Which of the following is an advantage that the mercury ballistic erection system has over the mercury erection system?

1. Greater sensitivity
2. Faster response time
3. Spin axis aligns in any desired position
4. Spin axis aligns north-south

2-49. What is the principal purpose of rate gyros?

1. To serve as gyroscopes
2. To serve as reference elements
3. To measure acceleration
4. To measure angular rates

2-50. In what maximum number of directions is a rate gyro free to precess?

1. One
2. Two
3. Three
4. Four

2-51. The amount of precession of a rate gyro is proportional to what input factor?

1. Rate of gyro case rotation
2. Amount of gyro case rotation
3. Rate of linear displacement
4. Amount of total movement

2-52. The operation of an accelerometer is based on what physical property?

1. Heat
2. Inertia
3. Gravity
4. Precession

2-53. Accelerometers find their greatest use in what type of system?

1. Navigation
2. Communication
3. Weapons control
4. Direction-indicating

2-54. Pulse-counting accelerometers are designed for use only with what type of equipment?

1. Radar sensors
2. Electronic compasses
3. Analog indicators
4. Digital computers

2-55. Which of the following is NOT a difference between IC synchros and standard synchros?

1. Amount of torque available
2. Construction of the stator
3. Construction of the rotor
4. Principle of operation

USE THE FOLLOWING INFORMATION IN ANSWERING QUESTIONS 2-56 AND 2-57. A SYNCHRO SYSTEM USING AN IC TRANSMITTER HAS THE REQUIREMENT THAT THE RECEIVER TURN IN THE OPPOSITE DIRECTION FROM THE TRANSMITTER.

2-56. If an IC receiver were used, what winding of the receiver would be connected to winding R1 of the IC transmitter?

1. R1
2. R3
3. S1
4. S1

2-57. If a standard synchro receiver were used, what winding of the receiver would be connected to winding R3 of the IC transmitter?

1. R1
2. R3
3. S1
4. S3

2-58. Angular data is to be transmitted and dc is the only power available. Which of the following systems should be used?

1. Resolver system
2. IC synchro system
3. Step-transmission system
4. Servo system using a CT and a dc servo motor

2-59. A step-transmission system is to be built in which the steps are to be smaller than the steps in the system shown on page 4-3 of the text. What must be done to the system shown in the text to accomplish this change?

1. Increase the number of coils
2. Decrease the number of coils
3. Increase the supply voltage
4. Decrease the supply voltage

2-60. Which of the following is an advantage that a step-transmission system has over a standard synchro system?

1. Smaller changes in data can be transmitted
2. Transmitted data is "smoother"
3. Synchronizing is not needed
4. Cost is considerably less

2-61. A resolver performs which of the following mathematical functions?

1. Differentiation
2. Trigonometric
3. Integration
4. Algebraic

2-62. Resolvers are used aboard a ship to keep a gun mount steady regardless of the pitch and roll of the ship. What characteristic of the resolver makes it especially useful for this application?

1. Provides instant solutions with constantly changing inputs
2. Provides higher power gain for greater accuracy
3. Uses error-rate damping for smoother solutions
4. Uses ac for greater efficiency

2-63. The (a) rotor and (b) stator of a resolver are best described by which of the following?

1. (a) A single coil
   (b) Three coils, wye-connected
2. (a) Two coils in parallel
   (b) Two coils in series
3. (a) Two coils in series
   (b) Two coils in parallel
4. (a) Two coils at right angles
   (b) Two coils at right angles